



Engineering Evaluation of Remedy Options

Eastern Drainage Ditch

*Dayco Corporation/L.E. Carpenter Superfund Site,
Wharton, New Jersey*

October 2016

*Prepared For
L.E. Carpenter & Company*

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Section 1

Introduction

This report documents an engineering evaluation of remedy options to address affected sediments in the Eastern Drainage Ditch adjacent to the Dayco Corporation/L.E. Carpenter (LEC) Superfund Site (Site) in Wharton, New Jersey.

1.1 Background

The Dayco Corporation/LEC Site (Site) is a former manufacturing facility located at 170 North Main Street, Wharton, New Jersey. In 1981, NJDEP conducted soil and groundwater sampling at the site. This investigation detected volatile organic compounds, base neutral compounds, metals and polychlorinated biphenyls (PCBs) in soil and groundwater. In addition, light non-aqueous phase liquid (LNAPL or floating product) was observed floating on the groundwater table. Subsequently, LEC and NJDEP entered into an Administrative Consent Order (ACO), in which LEC agreed to delineate and remediate the soil and groundwater contamination at the site.

In April 1985, the United States Environmental Protection Agency (USEPA) placed the Site on the National Priorities List, and in September 1986, NJDEP and LEC entered into an amended ACO to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. LEC conducted the RI/FS from 1986 to 1993, and in 1995 USEPA issued a Record of Decision (ROD), selecting a remedy to address the areas of concern at the Site (USEPA, 1995). USEPA assumed the lead enforcement role for the site in 2009, at which time the 2009 Unilateral Administrative Order (UAO) was issued to LEC by the USEPA (effective August 6, 2009). The UAO directed LEC to undertake the cleanup of limited residual soil hot spot areas (discovered during post-remedy groundwater monitoring) and continue a natural attenuation groundwater study that was being conducted at the site.

TRC, on the behalf of LEC, has been investigating the nature and extent of diethylhexyl phthalate (DEHP) in soil, groundwater, pore water, and surface water on and adjacent to an area of the Site referred to as the MW-30 (or Wetland) Area. These investigations most recently included an Ecological Evaluation of the Eastern Drainage Ditch which is situated adjacent to and north of the MW-30 Area.

The Eastern Drainage Ditch is a man-made feature which lies entirely on the adjoining Air Products and Chemicals, Incorporated (APCI) property. Documents reviewed by TRC suggest that this semicircular ditch was constructed to control runoff from the APCI property, which was developed for industrial use in the mid-1960s. The Eastern Drainage Ditch appears to be connected to the Rockaway River by a northwest to southeast trending drainage feature referred to as the Unnamed Tributary. Water depth in the Eastern Drainage Ditch is controlled

by the beaver dam(s) on this drainage feature, and ranges from less than 6 inches in the western arm to more than three feet near the outlet to the Unnamed Tributary. Flow in the Eastern Drainage Ditch is negligible. The bottom consists of decaying organic matter, silt, sand, and clay and rock. Deeper water areas support submerged aquatic vegetation, such as watershield and naiads. Emergent vegetation, such as cattails and arrowhead, border the shoreline, especially in the western arm adjacent to the LEC Site.

Section 2 summarizes the Ecological Evaluation activities for the Eastern Drainage Ditch that were originally documented in the Ecological Evaluation Report (TRC, August 2016).

1.2 Purpose and Scope of Engineering Evaluation

The purpose of this engineering evaluation is to identify a preferred option to address site-related constituents in the Eastern Drainage Ditch with a potential to result in adverse ecological effects to benthic/aquatic populations. The engineering evaluation will evaluate the need for and extent of remedy components.

Section 2

Summary of Ecological Evaluation

The Ecological Evaluation activities for the Eastern Drainage Ditch were conducted in accordance with the April 6, 2016, Work Plan for Ecological Evaluation of the Eastern Drainage Ditch and Rockaway River (Work Plan; TRC, 2016) which was reviewed and approved by the USEPA on April 27, 2016. The Ecological Evaluation Report was submitted for agency review on August 15, 2016. The Eastern Drainage Ditch, a manmade surface water conveyance, was included in the Ecological Evaluation as a related area due to its proximity and hydrologic connection to an adjoining New Jersey jurisdictional wetland and the Rockaway River.

The Ecological Evaluation, which included upstream/reference sampling, surface water and sediment sampling, and community surveys, concluded that completed migration pathways have historically existed from the Site to the Eastern Drainage Ditch and from the Eastern Drainage Ditch to the adjoining wetland and Rockaway River. DEHP observations in the Eastern Drainage Ditch are likely attributable to migration from the LEC Site prior to significant source removal actions conducted from 2005 to 2009. Current DEHP migration potential to surface water is minimal due to reduced DEHP concentrations remaining on site, and DEHP's low solubility, and affinity for and partitioning to, aquifer materials and sediment.

Based on the nature and extent of DEHP distribution in the Eastern Drainage Ditch and community surveys, the Ecological Evaluation further concluded that:

- DEHP is not present at concentrations in Eastern Drainage Ditch surface water that would pose an adverse ecological impact to aquatic populations.
- The habitat quality of the Eastern Drainage Ditch was scored as “marginal” given that it is a man-made feature with a lack of flow/low velocity, heavy sediment deposits, fine/heavy muck substrate and an absence of riffles/bends.
- Though the Eastern Drainage Ditch habitat is rated as marginal, benthic macroinvertebrate sampling, fish survey, and incidental observation data indicate that the feature functions as a wetland/open water habitat that is utilized by a variety of species representing multiple trophic levels.
- The marginal habitat of the Eastern Drainage Ditch in conjunction with the observed DEHP concentrations in ditch sediments pose a potential adverse ecological impact to benthic populations.

In summary, the Eastern Drainage Ditch sediments were considered a potential medium of concern, and a recommendation to evaluate engineering options to address affected sediment in

the Eastern Drainage Ditch was included in the Ecological Evaluation Report. In USEPA comments received on the Report on September 15, 2016, the “Agencies support[ed] the recommendation to evaluate engineering options to address affected sediment in the Eastern Drainage Ditch.”

Section 3

Remedy Selection Criteria

This section presents the criteria that will be used to evaluate the engineering options for the Eastern Drainage Ditch. The engineering option selection will be based on the following:

- Protecting human health and the environment
- Other relevant factors:
 - Long-term reliability and effectiveness
 - Reduction in toxicity, mobility or volume of wastes
 - Short-term effectiveness
 - Implement ability/accessibility
 - Minimal impact to adjacent wetland areas
 - Green and sustainable remediation
 - Cost

3.1 Remedy Objectives

Remedy objectives define the goals for protection of human health and the environment and form the basis of engineering options development and comparison of various management options to reduce and maintain acceptable levels of potential risk. The preliminary remedy objectives for the Eastern Drainage Ditch were developed from the conceptual site model and results of the site-specific Ecological Evaluation.

The overall purpose of the remedy objectives is to clearly define both the desired outcomes of the remedy implementation and what the remedy is supposed to achieve in order for it to be considered a success. The remedy objectives for the Eastern Drainage Ditch include goals for the protection of human health and the environment and for the management of contaminant migration potential. These remedy objectives are presented and discussed below.

- Minimize exposure of benthic/aquatic communities to affected sediment in the Eastern Drainage Ditch
- Minimize migration of affected sediment in the Eastern Drainage Ditch, to the extent practicable.
- Maintain the current and anticipated future uses of the Eastern Drainage Ditch.

- Minimize the adverse effects of remediation activities on the existing aquatic environment and/or wetland habitat, to the extent practicable.

3.2 Media of Concern

For the purposes of this engineering evaluation of remedy options, the medium of concern is limited to DEHP-affected sediment in the Eastern Drainage Ditch. As presented on Figure 3-1, the Eastern Drainage Ditch was segmented into three reaches for the purpose of this engineering evaluation based on DEHP distribution and reach characteristics. Table 3-1 summarizes the description and reach-specific attributes. In Sections 4 and 5, the various remedy options are evaluated with consideration for each reach of the Eastern Drainage Ditch to determine the most effective and cost effective course of action for DEHP-containing sediments.

Table 3-1
Eastern Drainage Ditch – Summary of Reach Characteristics and Conditions

DITCH SEGMENT	DESCRIPTION	CHARACTERISTICS	DIMENSIONS
Reach 1	Western arm of the Ditch from the start of the Ditch down to 100 feet before the confluence with the Unnamed Tributary	<ul style="list-style-type: none"> Reach 1 is immediately adjacent to the 2005 Source Reduction Area on the LEC Site. Reach 1 Includes ponded area at confluence with the Unnamed Tributary Receives runoff from LEC Site, APCI Property and commercial buildings along E. Dewey Ave. Historical ACPI storm water outfalls 002 and 003 were located within Reach 1 (see Figure 3-1). Affected sediment likely represents historical impacts from overland flow or groundwater discharge prior to 2005 Source Reduction. Deeper sediments exhibit higher DEHP concentrations than the surficial interval. The DEHP distribution within the sediment profile indicates that older sediments affected by historical DEHP migration from the Site are being covered by newer native/regional sediment loads from upstream cleaner portions of the Ditch. 	<ul style="list-style-type: none"> 700 Linear Feet For the purposes of this evaluation, entire depth of the sediment bed (~average 2 feet) would be considered for remedy. Average Width – 8 feet 415 Cubic yards (in place)
Reach 2	The lateral portion of the Ditch beginning 100 feet before the confluence with the Unnamed Tributary preceding east to the southeast corner	<ul style="list-style-type: none"> Portion of the Ditch not adjacent to, nor receiving runoff from the LEC Site. Receives direct runoff from APCI property and lands east of the APCI property and north of E. Dewey Ave. Historical ACPI process water outfall 001 and storm water outfall 004 ultimately discharged into Reach 2 (see Figure 3-1). Shallow sediment in Reach 2 displays higher DEHP concentrations than deeper sediment. Deep sediment is unaffected by DEHP. The DEHP distribution within the sediment profile indicates that the limited DEHP-affected sediment in Reach 2 is likely the result of storm-facilitated migration from Reach 1 covering clean, older sediment. 	<ul style="list-style-type: none"> 350 Linear Feet For the purposes of this evaluation, only the upper 6 inches of sediment would be considered for remedy. Average Width – 6 feet 40 Cubic yards (in place)

Table 3-1
Eastern Drainage Ditch – Summary of Reach Characteristics and Conditions

DITCH SEGMENT	DESCRIPTION	CHARACTERISTICS	DIMENSIONS
Unnamed Tributary	The conveyance connecting the Ditch to the Rockaway River beginning at the confluence with the Ditch to the beaver dam	<ul style="list-style-type: none"> • Outlet for the Eastern Drainage Ditch. • Unnamed Tributary is not adjacent to, nor receiving direct runoff from the LEC Site • Bordered on both sides by jurisdictional wetlands. • Flow in the Unnamed Tributary is controlled by beaver dams • Minimally affected sediment in the Unnamed Tributary is likely the result of limited storm-facilitated migration from Reach 1. 	<ul style="list-style-type: none"> • 250 Linear Feet • For the purposes of this evaluation, only the upper 6 inches of sediment would be considered for remedy. • Average Width – 4 feet • 20 Cubic yards (in place)

Section 4

Identification and Screening of Candidate Technologies

This section evaluates cleanup technologies including general response actions (GRAs) and candidate remedy technologies for possible application to the three Eastern Drainage Ditch reaches identified in Section 3. Identified technologies follow USEPA guidance for screening against implementability, effectiveness, and cost. Screening results guide selection of potentially applicable technologies that will be retained for consideration as remedy option components in order to accomplish the remedy objectives.

The remedy objectives described in Section 3 establish the basis for identifying GRAs for the Eastern Drainage Ditch. GRAs are selected to address the extent of contamination and the potential for migration of DEHP from sediment. Response actions are described in broad categories in order to encompass the possible remedies. Remedy technologies include process options or specific technologies within each response action, such as alternative cap designs and various types of dredging technologies. GRAs considered for the Eastern Drainage Ditch include:

- No Action
- Containment
- Removal, treatment and disposal

4.1 Description and Screening of Remedy Technologies

Remedy technologies as related to GRAs identified and considered in this engineering evaluation include the following:

- No Action
- Containment – Thin Layer Cap and Engineered Cap
- Removal, Treatment, and Disposal –Mechanical Dredging and Hydraulic Dredging

Descriptions of these technologies and the conclusions regarding further consideration in the compiled remedy option are summarized in the following sections.

4.1.1 No Action

Under No Action, no remedy, including removal or containment of contaminated sediment, treatment, engineering controls, or institutional controls, is implemented. According to USEPA's 1988 RI/FS Guidance, No Action may include monitoring of conditions in order to verify that no unacceptable exposures to hazardous substances occur in the future. However, for this engineering evaluation, the No Action option does not include any monitoring component or review.

This option is generally appropriate in situations where contamination at a site presents no current or potential excess risk to human health or the environment, when the net environmental benefit of any active remedy is severely negative, or when a previous response action has eliminated the need for additional actions to be implemented. The ponded area at the confluence with the Unnamed Tributary (included in Reach 1) likely functions as a sediment trap where velocity slows and sediment mobilized by storms, if any, drops out of suspension. This dynamic mitigates potential storm-facilitated migration of sediment into Reach 2 and the Unnamed Tributary. As a result, Reach 2 and the Unnamed Tributary are minimally affected, and an active containment or removal option would not translate into overall positive environmental benefit when weighed against the degree of impact from clearing for staging and implementation. In particular, an active remedy would result in significant impact to the wetland environment bordering the southern boundary of Reach 2 and both sides of the Unnamed Tributary. No Action is a viable option for Reach 2 and the Unnamed Tributary.

- **Implementability** – The No Action option would be easily implemented technically and administratively.
- **Effectiveness** – The remedy objectives for Reach 1 would not be achieved under a No Action option within a reasonable time frame. As discussed, Reach 2, sourced primarily by the APCI property, and the Unnamed Tributary, which bisects the jurisdictional wetland, are minimally affected. As such, net environmental benefit considerations support No Action as a viable option for Reach 2 and the Unnamed Tributary.
- **Cost** – No costs would be associated with implementing the No Action option.

Conclusion: The No Action option is not an appropriate option for Reach 1. No Action will be retained as a viable option for Reach 2 and the Unnamed Tributary.

4.1.2 Containment

Containment systems used for contaminated sediment consist of sub-aquatic caps or engineering controls for which the primary functions are preventing exposure to or migration of contaminants, reducing the ability of burrowing organisms to move contaminants to the surface, and/or stabilizing the contaminated media to prevent transportation, sedimentation, or suspension in the water body. Caps are generally constructed of granular material (clean sediment, sand, or gravel), but can also include geotextiles, impermeable liners, and other materials to attenuate the flux of contaminants (USEPA, 2005). Containment systems also typically require monitoring and periodic maintenance to ensure that the system is functioning as intended. Finally, the use of a containment system as a remedy option for sediments within a water body assumes that upland source control and minimal potential for recontamination from upstream sources via sediment transport is established.

The screening of the Thin Layer Cap and Engineered Cap options are discussed in the following narrative.

Thin Layer Cap

The Thin Layer Cap option is the process of enhancing the natural sedimentation processes when these processes would not be expected to achieve cleanup in a reasonable time frame. The method involves placement of a thin layer of clean sand material over affected sediments to supplement the existing natural burial rate. For the Eastern Drainage Ditch, this remedy option contemplates the placement of a thin (5 to 10 cm) layer of clean sand, to achieve acceptable DEHP concentrations in the bioactive layer and to enhance the natural recovery process. This sand layer provides greater resistance to sediment erosion and mobility and provides a sacrificial layer of clean material above the contaminated sediment should storm-facilitated surface sediment mobility occur.

A synopsis of the technology screening assessment follows:

- **Implementability** – TRC has extensive field experience with the application of Thin Layer Cap options. Broadcast application has proven to be a suitable application approach for thin layer caps over soft sediments. The relatively small scale and accessibility of Reach 1 and Reach 2 and the limited surface water velocity would allow for easy implementation of a Thin Layer Cap. Monitoring post placement is typically used to verify uniform coverage.

- **Effectiveness** – The Thin Layer Cap option would be effective in reducing DEHP concentrations in the bioactive sediment layer and would achieve remedy objectives if the thin-layer cap is properly designed, constructed, and maintained. The Thin Layer Cap option using inert materials would minimize the bioavailability and transport of DEHP to the water column. The Eastern Drainage Ditch is not routinely susceptible to sediment scour based on limited surface water velocity, so long-term effectiveness for the Thin Layer Cap would be anticipated.

Since a capping system leaves contaminants in place, long-term maintenance and management is needed in order to ensure that the cap is continuing to function as intended since capping materials could migrate over time resulting in thin spots. Therefore, this type of cap may need to be re-applied periodically depending on the nature of material migration. Given Reach 1 and Reach 2 contain extremely soft sediments and Reach 1 contains sediments with relatively high DEHP concentrations that could be re-exposed in the event of a cap thinning or breach, the Thin Layer Cap option is not the preferred approach for Reach 1 or Reach 2.

In addition, given that Reach 2 and the Unnamed Tributary are minimally affected, and the clearing required for staging and application of the Thin Layer Cap option would result in significant impact to the adjacent wetland environments, this remedy option is not considered for either Reach 2 or the Unnamed Tributary.

- **Costs** – Construction costs would be low to moderate. Long-term costs for a Thin Layer Cap option would include remedy performance monitoring and cap maintenance activities.

Conclusion: Containment with a thin-layer cap is not retained for further evaluation in any Reach.

Engineered Cap

Engineered capping isolates contaminants from the overlying water column and prevents direct contact with aquatic biota through the use of a manmade membrane or a thick layer of clean natural material(s). As a result, the cap provides new unimpacted substrate for recolonization by benthic organisms. Capping is generally considered effective at isolating low-solubility and highly sorbed contaminants like DEHP, where the principal transport mechanism is sediment resuspension and deposition. Engineered Cap designs should also minimize the potential for sediment re-suspension under normal and extreme (storm) conditions.

Installation of an Engineered Cap at the Eastern Drainage Ditch could require removal of sediment given a need to maintain sufficient water depth and storm water flow capacity. Capping materials are placed over the sediment as a barrier, isolating contaminants within the substrate and, when applicable, reducing the scour of contaminated sediment.

Site-specific issues that impact the technology screening for an Engineered Cap are discussed below.

- **Implementability** – Conventional sand caps and armored sand caps have been successfully placed over contaminated sediments in stream and riverine environments. Average cap thickness in other settings has ranged from 1 to 5 feet in thickness, and post-cap sediment cores show effective isolation of underlying material in most cases. It is unlikely that the soft sediments in the Eastern Drainage Ditch would support a 1-foot (or greater) thick engineered cap. Considerable consolidation under the weight of the cap would be expected and isolated side-slope failures could occur. The small scale of the Eastern Drainage Ditch would make a structured engineered cap difficult to implement.
- **Effectiveness** – Capping is an effective technology to isolate contaminants from the overlying water column and to prevent direct contact with aquatic biota. In addition, if topped with clean sand, capping provides a new clean substrate for recolonization by benthic organisms. The impact to habitat and long-term use of the water feature must be considered in selection of a capping option. The small scale of the Eastern Drainage Ditch would likely experience issues with changes to the water depth, substrate type, and effect on local storm water flow dynamics.

The integrity of engineered caps can be compromised by gas generated from decomposing soft sediments or even cap components. Given the Ditch is highly vegetated gas generation could be an issue.

The area required for staging and clearing for implementation of an Engineered Cap option would result in significant impact to the adjacent wetland environments, for both Reach 2 and the Unnamed Tributary.

- **Cost** – Costs for engineered capping would be moderate with respect to more active approaches involving removal, treatment, and disposal.

Conclusion: Containment with an engineered cap is not retained for further evaluation in any Reach.

4.1.3 Removal, Treatment, and Disposal

Removal technologies are employed in those cases where contaminated sediments are to be withdrawn for *ex situ* treatment, confinement, or disposal. Sediment removal can be conducted “in the wet” by dredging techniques or “in the dry” by excavation methods.

Dredging is one of the most common sediment remedies used to date. With careful planning, application in appropriate environments, and use of engineering controls, dredging can be an effective tool to remove contaminated sediment. However, recent research indicates that dredging may not be an effective remedy option for many environments, due to the re-suspension of contaminated sediment and the difficulty associated with complete removal of the targeted mass.

Based on a review of historical dredging/excavation projects, removal of fine-grained sediment deposits are the most challenging and have the highest potential to increase suspended solids in the water column as well as allow residuals to settle downstream of the dredged area. Proper control of the dredging operations and the use of engineering controls are primary means of controlling sediment resuspension and redeposition. To be effective, best management practices for environmental dredging and silt curtain barriers would need to be deployed around the dredging operation. Silt curtains must remain in place during dredging/excavation operations and for a period of time after placement to minimize downstream transport or resuspended sediment. The most recent USACE guidance on dredging recommends that the silt curtains be deployed across the width of the channel. Following removal, sediments must be staged, dewatered, and disposed offsite.

Mechanical excavation/dredging and hydraulic dredging are the two most common methods of physically removing sediments from a water body. Mechanical excavation/dredging can be conducted “in the wet” or “in the dry.” Mechanical and hydraulic dredging options are briefly discussed below.

Mechanical Excavation/Dredging

Mechanical excavation/dredging in the wet consists of removing sediments through the water column. In addition to some of the same site conditions that constrain mechanical excavation/dredging in the dry, mechanical excavation/dredging in the wet would also require engineering controls, such as silt curtains, to prevent the migration of resuspended sediments. Under suitable conditions, mechanical dredges or excavators are capable of removing sediment at near *in-situ* densities, with almost no additional water entrainment

in the dredged mass and little free water in the filled bucket. Low water content is important if dewatering is required for ultimate sediment treatment and upland disposal.

Hydraulic Dredging

Hydraulic dredging involves using a pump to create a vacuum at the dredgehead (*e.g.*, cutterhead, auger) to remove sediments, which are then transported via a pipeline to shore for dewatering and further treatment. The hydraulic process introduces a large amount of water and can yield a low removal of solids (typically in the range of 3 to 12 percent by wet weight) depending upon the type of sediment being handled. The site conditions described above for mechanical dredging would also constrain hydraulic dredging. For hydraulic dredging to be successful, debris removal must be completed prior to dredging.

Specific issues that impact the technology screening for the Dredging option are discussed below.

- **Implementability** – Mechanical and hydraulic removal options in the wet would be implementable at the Eastern Drainage Ditch, but hydraulic options may be impracticable due to increased water management requirements. The water depth variability and small size of the Eastern Drainage Ditch would require that mechanical excavation/dredging be completed with a land-based trackhoe. The excavation equipment would likely require multiple access and staging areas on the Eastern Drainage Ditch, depending on the size of the equipment.

Vegetation is present on the Ditch bottom, and can be easily removed with sediment under the mechanical excavation option. The design of temporary engineering control measures to minimize sediment resuspension and downstream transport during dredging activities.

As mentioned previously, the large volumes of water associated with hydraulic dredging is an implementation issue. Removed water must be treated on site to meet relevant standards before being discharged to nearby surface water. Finally, solids must be separated, dewatered, and prepared for off-site disposal. The construction of a large upland sediment staging/handling areas to de-water and/or stabilize sediments would also be required. These on-shore processing steps and material handling requirements would limit the rate for sediment removal and affect the practicability of the hydraulic dredging technology.

Additional potential hindrances to effective implementation of dredging in the Unnamed Tributary include the clearing and grubbing of 3 to 5 acres of wetlands to

allow access. Administrative barriers would make implementation difficult because of the loss of wetlands, and the expected damage to the wetlands functionality. Given that the Unnamed Tributary is minimally affected, and implementation of an excavation option would result in significant impact to the wetland environment, a removal remedy is not considered for the Unnamed Tributary.

- **Effectiveness** – Both hydraulic and mechanical dredging are effective means of removing sediments from waterways. However, their effectiveness becomes limited when environmental constraints are imposed on the project. Achieving re-suspension goals during dredging, and targets for concentrations in residual sediments after dredging, are challenges. The physical mixing action of the dredge stirs up sediments, releasing both suspended solids and dissolved constituents into the water column. Further, any dredging method would result in the temporary destruction of the benthos and habitat in the dredged area.

Given the small size of the Ditch, resuspended sediments could be managed effectively with focused engineering control measures during the short duration of active dredging.

Given that Reach 2 and the Unnamed Tributary are minimally affected, and staging and clearing required for implementation of a removal option would result in significant impact to the adjacent wetland environments, a removal remedy is not considered for either Reach 2 or the Unnamed Tributary.

- **Cost** – Costs associated with dredging and dewatering systems are expected to be high in relation to the other technologies. Implementation costs for mechanical and hydraulic dredging are similar, with dewatering costs for hydraulic dredging being higher due to the increased water content.

Conclusion: Mechanical Dredging/Excavation will be retained for further evaluation for Reach 1. Hydraulic Dredging will not be retained for further evaluation for any reach.

4.2 Compiled Remedy Option

The compiled remedy option for the Eastern Drainage Ditch is proposed to include the following components:

- Reach 1 – Mechanical Dredging/Excavation
- Reach 2 – No Action
- Unnamed Tributary – No Action

Section 5

Analysis of the Compiled Remedy Option

This section describes the components of the compiled remedy option by reach and summarizes the performance of the proposed remedy option with respect to threshold criteria (overall protection of human health and the environment, compliance with ARARs) and balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost).

5.1 Reach 1 – Mechanical Dredging/Excavation

A summary of the evaluated remedy options' ability to meet the threshold and balancing criteria is provided with the description of each component.

This remedy option provides a removal response action with excavation/dredging for Reach 1. The purpose of excavation/dredging in Reach 1 is to reduce DEHP concentrations throughout the sediment profile and to reduce the potential for affected sediment mobility to other minimally impacted reaches.

Excavation/Dredging in Reach 1 is different from dredging in Reach 2 and the Unnamed Tributary based on DEHP distribution and sediment characteristics (refer to Table 3-1). In Reach 1, DEHP is present at relatively high concentrations at depth in the sediment profile. For Reach 2 and the Unnamed Tributary DEHP concentrations are an order of magnitude lower and limited to the upper 6 inches of sediment. Dredging is an appropriate response for the focused area of elevated DEHP concentration in Reach 1, but not cost effective in the other reaches due to the minimal DEHP impacts, as well as the ease of access and maneuvering of removal equipment without collateral environmental damage.

Threshold Evaluation: Excavation/dredging may be the option that has the greatest amount of mass removal and the worst short term adverse impacts. It is expected that mechanical dredging will resuspend sediment from Reach 1 that may remain in the water column for extended time and may not reconsolidate quickly. However, given the limited flow in the Eastern Drainage Ditch and the ease with which engineering control measures could be deployed within Reach 1, the resuspension impacts can be managed. Excavation/dredging can result in residual concentrations after the materials have re-settled. To the extent that affected residuals remain, dredging can be followed by rehabilitation of the sediment bed (placement of sand) to reduce available concentrations of DEHP. Dredging and limited sediment bed

rehabilitation will achieve the threshold criteria of overall protection of the environment in Reach 1.

Balancing Evaluation: The main balancing criterion that is met with dredging is the reduction in mass and volume. This remedy component is the most expensive to implement, but is appropriate and cost effective when focused on the elevated DEHP concentrations in Reach 1 only. Short-term concerns include resuspension of DEHP-containing sediment during excavation as previously discussed.

Cooperation with APCI would be required for this option since Reach 1 of the Eastern Drainage Ditch is located entirely on the APCI property.

Costs: A conceptual-level cost range of \$420,000 to \$550,000 has been developed for mechanical dredging/excavation and off-site disposal of Reach 1 sediments. For planning purposes, a cost range of \$5,000 to \$10,000 is also estimated for a one-time performance monitoring event 2 to 3 years post remedy to confirm remedy effectiveness and habitat recovery. Actual monitoring parameters and timing will be determined during the design of the remedy.

5.2 Reach 2 – No Action

Reach 2 represents a portion of the Eastern Drainage Ditch not adjacent to, nor receiving runoff from, the LEC Site. Reach 2 is marginally affected with DEHP in sediments and partially bordered by wetlands. Reach 2 displays a relatively low DEHP concentration compared to Reach 1. In addition, the distribution of DEHP in Reach 2 includes limited DEHP observations in the 0- to 0.5-foot interval, where DEHP is not detected in the 0.5-to 1.0-foot interval. Based upon the limited environmental impact, the disruption and harm that would be done to the environment and the adjacent wetlands would be greater than that currently posed by the limited environmental observations.

Threshold Evaluation: As stated previously, burial of affected sediments is observed in various locations within the Eastern Drainage Ditch. Natural recovery processes will continue in Reach 2 of the Eastern Drainage Ditch. Further, remedy options for Reach 1 will eliminate the potential for migration of DEHP-containing sediment.

Balancing Evaluation: Under the No Action option, this option is implementable with no adverse short-term impacts.

Costs: There are no costs associated with implementing the No Action option for Reach 2.

5.3 Unnamed Tributary – No Action

Unnamed Tributary is completely surrounded by wetlands and is very inaccessible. The tributary is also partially located on property owned by Wharton Enterprises and partially on property owned by the State of New Jersey which would make coordination of the remediation difficult to complete. The Unnamed Tributary is marginally affected with DEHP in sediments. Based on the inaccessibility, location, and limited environmental impact, TRC believes the harm that would be done to the wetlands would be greater than the limited environmental impact.

Threshold Evaluation: The No Action option will not, in and of itself, be effective in significantly reducing or eliminating the limited DEHP concentrations in sediment. As stated previously, burial of affected sediments is observed in various locations within the Eastern Drainage Ditch. Natural recovery processes will continue in the Unnamed Tributary. Further, remedy options for Reach 1 will serve to eliminate potential for migration of DEHP containing sediment from this upstream area.

Balancing Evaluation: Under the No Action option, this option is implementable with no adverse short-term impacts.

Costs: There are no costs associated with implementing the No Action option for the Unnamed Tributary.

Section 6

Conclusions and Recommendations

The Engineering Evaluation of Remedy Options concludes that the most cost effective and protective remedy option for the Eastern Drainage Ditch includes the following components:

- Reach 1 – Mechanical Dredging/Excavation
- Reach 2 – No Action
- Unnamed Tributary – No Action

TRC recommends moving forward with a Work Plan for Pre-Design Data Gathering and Design in support of the recommended remedy option for the Eastern Drainage Ditch.